

## CLAIMS

1. An apparatus for producing a beam of charged particles, comprising an  
5 emitter (1, 2) and a switching device (3) adapted to switch between first, second and third beam current levels, wherein the beam current at said first current level is suitable for writing a pixel of an image on the surface of a sample, the beam current at said second current level is suitable for not writing a pixel on the surface of said sample, and the  
10 beam current at said third current level is lower than the beam current at the second current level.
2. The apparatus according to claim 1, wherein said emitter is a field emission cathode (1, 2) and said switching device (3) is adapted to switch between first, second and third voltage levels of an extraction voltage of said field emission cathode (1, 2), wherein said first, second  
15 and third voltage levels correspond to said first, second and third current levels.
- 20 3. The apparatus according to claim 1 or 2, wherein said switching device (3) comprises a small voltage switching part (3a) for switching between voltages having a first difference, and a large voltage switching part (3b) for switching between voltages having a second difference which is larger than said first difference.  
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4. The apparatus according to claim 3, wherein said first difference is smaller or equal than 5 V and said second difference is greater or equal than 10 V, preferably about 15V.
- 30 5. The apparatus according to any of the preceding claims, comprising an array of field emission cathodes.

6. The apparatus according to claim 5, further comprising an electrode common to all field emission cathodes of the array for simultaneously switching the field emission cathodes between voltages having a second difference.

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7. A method for controlling the beam current of a charged particle beam comprising the steps of

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switching the beam current of said charged particle beam between first and second current levels, wherein the beam current at said first current level is suitable for writing a pixel of an image on the surface of a sample and the beam current at said second current level is suitable for not writing a pixel on the surface of said sample, and

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switching the beam current to a third voltage level, wherein the beam current at said third current level is lower than the beam current at the second current level.

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8. The method according to claim 7, wherein the ratio of the beam currents of said first and second current levels is smaller than the ratio of the beam currents of said second and third current levels.

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9. The method according to claim 7 or 8, wherein the ratio of the beam currents of said first and second current levels is larger or equal to  $10^2$ .

10. The method according to any of claims 7 to 9, wherein the ratio of the beam currents of said first and third current levels is larger or equal to  $10^4$ .

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11. The method according to any of claims 7 to 10, wherein said first current level is at 10 nA, said second current level is at 0,1 nA, and said third current level is at 1 pA.
- 5 12. The method according to any of claims 7 to 11, wherein the beam current is at the third current level when the charged particle beam performs a turn movement and/or a retrace movement.
- 10 13. The method according to any of claims 7 to 13, wherein the switching between said second and third current levels is performed when the charged particle beam moves over the sample surface at write scan speed.
- 15 14. A method for controlling the beam current of a charged particle beam comprising the steps

producing the charged particle beam by a field emission cathode,

20 switching the extraction voltage of said field emission cathode between first and second voltage levels, wherein said first voltage level is suitable for writing a pixel of an image on the surface of a sample and said second voltage level is suitable for not writing a pixel on the surface of said sample, and

25 switching the extraction voltage to a third voltage level, wherein said third voltage level is lower than said second voltage level.

15. The method according to claim 14, wherein the voltage difference between the first and second voltage levels is smaller than the difference between the second and third voltage levels.

16. The method according to claim 14 or 15, wherein the voltage difference between the first and second voltage level is smaller or equal than 5 V and the voltage difference between the second and third voltage level is greater or equal than 10 V, preferably about 15V.  
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17. The method according to any of claims 14 to 16, wherein the third voltage level is at about 5 V.
- 10 18. The method according to any of claims 14 to 17, wherein the extraction voltage is at the third voltage level when the charged particle beam performs a turn movement and/or a retrace movement.
- 15 19. The method according to any of claims 14 to 18, wherein the switching between said second and third voltage levels is performed when the charged particle beam moves over the sample surface at write scan speed.
- 20 20. The method according to any of claims 14 to 19, wherein the switching between any of the first, second and third voltage levels is performed by tip switching.
- 25 21. The method according to any of claims 14 to 20, wherein the switching between any of the first, second and third voltage levels is performed by gate switching.